

Nine new species of earthworms (Oligochaeta: Megascolecidae) of the Banaue Rice Terraces, Philippines

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Nine new species of earthworms (Oligochaeta: Megascolecidae) of the Banaue Rice Terraces, Philippines. - Earthworm specimens collected from the Philippines from Banaue, Ifugao Province belong to 9 new species of pheretimoid earthworms. Two new species of *Pheretima* as characterized by Sims and Easton (1972) were found, including *Pheretima banauensis* sp. n., and *Pheretima cabigati* sp. n. They have spermathecae in VII-VIII and VI-IX, respectively. Four new species of *Pithemera* are *Pithemera duhuani* sp. n., *Pithemera fragumae* sp. n. and *Pithemera ifugaoensis* sp. n. of the *Pi. bicincta* group, having spermathecae in segments V-IX, and *Pithemera triangulata* with three pairs of spermathecae in segment V-VII. Three new species of *Polypheretima* are *Polypheretima fruticosa* sp. n., *Polypheretima perlucidula* sp. n., and *Polypheretima bannaworensis* sp. n. with paired spermathecae in VI, VI-VII, and VI-IX, respectively. Descriptions of the new species are provided.

Keywords: Earthworms - *Pheretima* - *Pithemera* - *Polypheretima* - Megascolecidae - Oligochaeta - Philippines - taxonomy.

INTRODUCTION

The earthworm fauna of the forest and agricultural ecosystems in the municipality of Banaue, Ifugao Province, Philippines is dominated by the *Pheretima*-complex group of genera (Megascolecidae). The genera *Pheretima*, *Pithemera*, *Pleionogaster*, and *Polypheretima* are the most abundant and diverse in the natural forests of this region in the Central Cordillera of Luzon Island, Philippines. *Pheretima* has an intestinal caecum originating in segment XXVII, while *Pithemera* has an intestinal caecum originating in segment XXII, and *Polypheretima* is acaecate. *Pheretima* has male pores within copulatory pouches and nephridia on the spermathecal ducts, but *Pithemera* and the known Philippine *Polypheretima* do not have these features. Also *Pheretima* species generally have some dorsal pigment, but *Pithemera* are usually lighter, and *Polypheretima* are mostly unpigmented. So far, *Pithemera* and *Polypheretima* are generally smaller than *Pheretima*.

The early reports of earthworm fauna from Banaue rice terraces (Barley & Kleinig, 1964; Barrion & Litsinger, 1997; Joshi *et al.*, 2000) showed that there are 4 species belonging to four genera, *Polypheretima elongata* (Perrier, 1872), *Pontoscolex corethrurus* (Müller, 1856), *Pithemera bicincta* (Perrier, 1875) and *Amyntas corticis* (Kinberg, 1867). They also listed *Pheretima* sp., *Polypheretima* sp., two species of *Pleionogaster* and a large unidentified aethal large earthworm belonging to either *Pheretima* or *Metaphire*. The 4 known species are invasives widespread around the world. This paper provides descriptions of 9 species: 2 of *Pheretima*, 4 of *Pithemera* and 3 of *Polypheretima*. Materials were collected from 16-18 March 2001, in rice terrace regions and soils and litter layers of the nearby forests in the Banaue municipality.

Holotypes and paratypes are deposited in the National Museum of the Philippines Annelid collection (NMA). Paratypes are deposited in the Museum of Natural History of Geneva (MNHG), Korean National Institute of Biological Resources (NIBR).

DESCRIPTIONS

FAMILY MEGASCOLECIDAE ROSA, 1891

Genus *Pheretima* Kinberg, 1867

Pheretima banauensis sp. n.

Figs 1A-B

MATERIAL: Holotype, clitellate (NMA 4176), Philippines, Ifugao province, Banaue (16° 54.86'N, 121° 03.54'E), 1900 m, soil and litter layers, 17 March 2001, Y. Hong & A. Castillo colls. – 2 paratypes, 1 clitellate (NMA 4187), 1 clitellate (MHNG 49295), same data as for holotype. – Other material: 1 clitellate, Banaue (16° 55.39'N, 121° 04.38'E), 1280 m, soil and litter layers, 17 March 2001, Y. Hong & A. Castillo colls.

ETYMOLOGY: The species is named for its type locality.

DIAGNOSIS: Two pairs of spermathecal pores in 6/7, 7/8, 0.21 circumference apart; 0.5 mm openings of copulatory bursae surrounded by 1.5 mm diameter unpigmented epidermis.

DESCRIPTION: Brown dorsal pigment, segmental equators unpigmented. Dimensions 96-124 mm by 3.7-4.0 mm at segment X, 3.8-4.2 mm at XXX, 3.4-3.7 mm at clitellum, segments 86-97. Body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 27 at VII, 26 at XX; 7 between male pores; setal formula AA:AB:YZ:ZZ = 3:2:3.5:7 at XIII. Prostomium epilobic with tongue open. Clitellum annular XIV- XVI, setae invisible externally. Genital markings lacking.

First dorsal pore 12/13. Two pairs of spermathecal pores in 6/7, 7/8, lateral, 0.21 circumference apart ventrally. Female pore single in XVI, in 0.5 mm oval. Secondary male pores 0.5 mm diameter paired in XVIII, 0.21 circumference apart ventrally, surrounded by 1.5 mm diameter unpigmented epidermis; distance between male pores 2.5 mm.

Septa 5/6-7/8 thin, 8/9, 9/10 absent, 10/11-13/14 thin. Gizzard large in VIII-X with large longitudinal blood vessels, intestine begins in XVI, small paired lymph glands from XXVII along dorsal vessel; intestinal caeca simple, originating in XXVII,

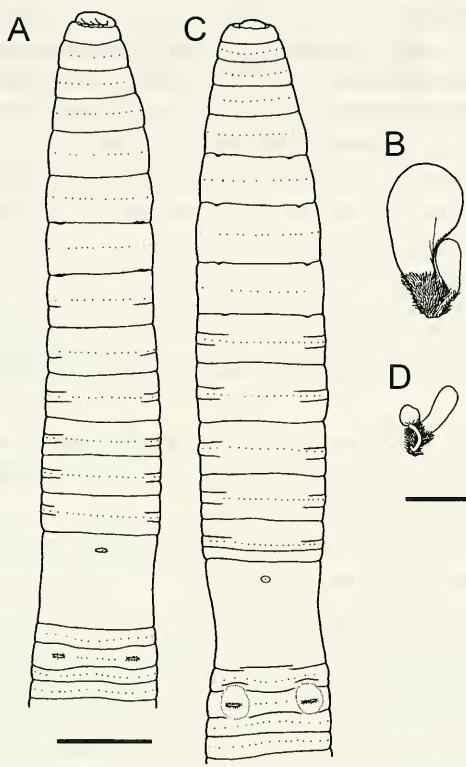


FIG. 1

Pheretima banauensis sp. n. (A) Ventral view. (B) Spermathecae and diverticulum. *Pheretima cabigati* sp. n. (C) Ventral view. (D) Spermathecae and diverticulum. Scale bars = 2.5 mm (A, C), 2 mm (B, D).

and extending anteriorly to XXIV or XXIII, each consisting of a finger-shaped sac; typhlosole low simple fold from XXVII; 28 longitudinal blood vessels in intestinal wall. Hearts X-XIII esophageal; IX, left side only, lateral.

Ovaries and funnels in XIII. Paired spermatheca in VII, VIII with nephridia on spermathecal ducts; spermatheca with circular to broad ovate-shaped ampulla, duct stout, short; diverticula bean-shaped, stalk 1/3 covered with nephridia, stalk shorter than ampulla. Male sexual system holandric, testes and funnels in paired sacs in X, XI. Seminal vesicles two pairs in XI, XII. Prostates in XVIII, one small lobe, curved around copulatory pouches, with duct entering center of the copulatory pouches; no stalked glands; penis with slit along medial surface, copulatory pouch opening flanked by anterior and posterior circular pads.

REMARKS: *Pheretima banauensis* sp. n. keys to the *pura*-group in Sims and Easton (1972), which is composed of three species, *P. philippina* (Rosa, 1891), *P. pura* (Rosa, 1898), and *P. tosariana* Cognetti, 1913. *P. philippina*, with three thecal seg-

ments, is wrongly placed in this species group, and should be in the *dubia*-group. The species is similar to *P. pura*, but differs from it in being shorter, having fewer setae per segment, and more closely spaced male pores. Also the species has hearts in X-XIII, but *P. pura* has hearts in XI-XIII. Compared to *P. tosariana*, *Pheretima banauensis* sp. n. is more slender, has more segments, fewer setae per segment, a stouter and shorter spermathecal duct, and lacks a side pocket of the spermathecal duct leading to the diverticulum as seen in *P. tosariana*. *P. tosariana* was collected at 2000 m elevation in the Tenger Mountains of eastern Java, Indonesia (Cognetti, 1913).

Pheretima cabigati sp. n.

Figs 1C-D

MATERIAL: Holotype, clitellate (NMA 4177), Philippines, Ifugao province, Banaue (16° 58.59'N, 121° 02.89'E), 1600-1665 m, soil and litter layers, 16 March 2001, Y. Hong & A. Castillo colls.

ETYMOLOGY: The species is named after Jimmy Cabigat, a Philippine Department of Agriculture official from Banaue and our host and guide while we were collecting earthworm specimens near Banaue.

DIAGNOSIS: Four pairs of spermathecal pores in 5/6-8/9, 0.22 circumference apart; 0.5 mm openings of copulatory bursae.

DESCRIPTION: Dark brownish dorsal pigment, segmental equators unpigmented. Dimensions 98 mm by 3.7 mm at segment X, 4.0 mm at XXX, 3.4 mm at clitellum, segments 89; body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 26 at VII, 33 at XX; 6 between male pores; setal formula AA:AB:YZ:ZZ = 1.5:1:5:7 at XIII. Prostomium epilobic with tongue open. Clitellum annular XIV-XVI; setae invisible externally. Genital markings lacking.

First dorsal pore 12/13. Four pairs of spermathecal pores in 5/6/7/8/9, 0.3 circumference apart ventrally; distance between spermathecal pores 3.4 mm. Female pore single in XIV, on 0.4 mm oval; 0.5 mm openings of copulatory bursae paired in XVIII, 0.22 circumference apart ventrally; distance between male pores 2.4 mm.

Septa 5/6-7/8 thin, 8/9 absent or vestigial, 9/10 absent, 10/11-13/14 thin. Gizzard in VIII-X, intestine begins in XVI, small paired lymph glands from XXX along dorsal vessel; intestinal caeca simple, originating in XXVII, and extending anteriorly about to XXIII, each consisting of a finger-shaped sac, directed ventrally; typhlosole simple fold about 1/4 lumen diameter from XXVII; 26-28 longitudinal vessels in intestinal wall. Hearts X-XIII esophageal; IX, lateral, VIII, VII lateral reduced.

Ovaries and funnels in XIII. Spermathecae in VI-IX, with nephridia on spermathecal ducts and diverticulum stalks; spermatheca with small elongate oval to strawberry-shaped ampulla; diverticula spherical to blunt egg-shaped, shorter than ampulla. Male sexual system holandric, testes and funnels in paired sacs in X, XI. Seminal vesicles two pairs in XI, XII, vas deferens slightly muscular. Prostates in XVIII, occupying in XVI-XIX, duct thick, glands two lobes, with duct entering center of ovate copulatory pouches; no stalked glands. Copulatory pouches openings flanked by anterior and posterior circular cup-shaped pads, penis conical with medial slit pore extending to tip.

REMARKS: *Pheretima cabigati* sp. n. keys to the *darnleiensis*-group in Sims and Easton (1972). The *darnleiensis* group is composed of fifteen species, all of which were synonymized by Sims and Easton (1972) under *P. darnleiensis*. *Pheretima cabigati* sp. n. differs from *P. darnleiensis* in having fewer setae per post-clitellar segment, intestinal origin 16 not 15, and in having dark brown dorsal pigment and unpigmented setal lines.

Pithemera duhuani sp. n.

Figs 2A-B

MATERIAL: Holotype, clitellate (NMA 4178), Philippines, Ifugao province, Banaue ($16^{\circ} 58.59'N$, $121^{\circ} 02.89'E$), 1600-1665 m, soil and litter layers, 16 March 2001, Y. Hong & A. Castillo colls. – Other material: same data as for holotype, 1 clitellate and 1 a clitellate specimens.

ETYMOLOGY: The species is named after Andres Duhuan, whose farm is its type locality.

DIAGNOSIS: Five pairs of spermathecal pores in 4/5-8/9. Genital papillae 0.3 mm raised circles, widely paired in XVII with sessile glands.

DESCRIPTION: Brown dorsal pigment, clitellum with pink color. Dimensions 53-59 mm by 2.5-2.7 mm at segment X, 2.4-2.5 mm at XXX, 2.0-2.3 mm at clitellum, segments 87-90. Body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 40 at VII, 39 at XX; 6-7 between male pores; setal formula AA:AB:YZ:ZZ = 3:1.5:2:4 at XIII. Prostomium epilobic with tongue open. Clitellum annular XIV-1/2XVI; setae visible externally. Genital papillae 0.3 mm raised circles, widely paired in XVII, XIX (right side only) or XVIII only.

First dorsal pore 4/5. Five pairs of spermathecal pores in 4/5-8/9, very small, inconspicuous, 0.14-0.15 circumference apart ventrally; distance between spermathecal pores pores 1.2 mm. Female pores paired in XIV, in small circular area. Male pores superficial, slightly protuberant white spot on center of 0.4 mm round porophore in lateral margin of ventrum in XVIII, some furrows around porophores, 0.32-0.37 circumference apart ventrally; distance between male pores 2.3 mm.

Septa 5/6-7/8 thin, 8/9 absent, 9/10-13/14 thin. Gizzard usual in VIII-IX, intestine begins in XV; intestinal caeca simple, originating in XXII, and extending anteriorly about to XXI (or XXII), each consisting of a small finger-shaped sac; typhlosole simple fold about 1/6 lumen diameter from XXII. Hearts X-XII esophageal; IX lateral.

Ovaries and funnels in XIII. Spermatheca in V-IX; no nephridia on spermathecal ducts; spermatheca with small ampulla, duct medium thickness, shorter than ampulla; diverticulum egg-shaped, shorter than ampulla. Male sexual system holandric, testes and funnels in single large sacs in X, XI. Seminal vesicles two pairs in XI, XII. Prostates in XVI-XIX without copulatory pouches, ectal half of duct muscular, spindle-shaped. Sessile genital marking glands paired in XVII and right side XIX.

REMARKS: *Pithemera duhuani* sp. n. keys to the *bicincta*-group in Sims and Easton (1972), which is composed of two species, *Pi. bicincta* (Perrier, 1875) and *Pi. violacea* (Beddard, 1895) with spermathecal pores in 4/5-8/9. However, others have stated that *Pi. violacea* is a junior synonym of *Pi. bicincta* (Michaelsen, 1910; Ohfuchi, 1957; Shen & Tsai, 2002). James *et al.* (2004) recorded 2 species of *Pithemera* from

Mt. Arayat, Luzon Island, *Pi. rotunda* and *Pi. philippinensis*. These two species also key to the *bicincta* group. The spermathecae are not greatly different between *Pithemera duhuani* sp. n. and *Pi. bicincta*, but the size, numbers, and location of genital papillae are different in *Pi. bicincta* and *Pithemera lanyuensis* Shen & Tsai, 2002. *Pithemera duhuani* sp. n. has raised circles widely paired in XVII and XIX, but *Pi. bicincta* has a pair of pads covering segments XVIII to XIX, and *Pi. lanyuensis* has round paired genital papillae. The present new species has fewer setae than most of its group members.

Pithemera fragumae sp. n.

Figs 2C-D

MATERIAL: Holotype, clitellate (NMA 4179), Philippines, Ifugao province, Banaue (16° 54.97'N, 126° 03.60'E), 1070 m, soil and litter layers, 16 March 2001, Y. Hong & A. Castillo colls. – 3 paratypes: 1 clitellate (NMA 4188), 1 clitellate (MHNG 49296), 1 clitellate (NIBR). Same data as for holotype. – Other material: same data as for holotype, 11 clitellate specimens.

ETYMOLOGY: The epithet *fragumae*, Latin for strawberry, refers to the conspicuous spermathecal ampulla in this species.

DIAGNOSIS: Five pairs of spermathecal pores in 4/5-8/9. Genital papillae, circular, paired in XVII and pre and postsetal next to male pores in XVIII within male porophore.

DESCRIPTION: Worm unpigmented. Dimensions 53-101 mm by 2.8 mm at segment X, 2.7 mm at XXX, 2.3 mm at clitellum, segments 122-129. Body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 66 at VII, 69 at XX; 10-15 between male pores; setal formula AA:AB:YZ:ZZ = 2:1:1:2 at XIII. Prostomium epilobic with tongue open. Clitellum annular XIV-1/2XVI; setae invisible externally. Genital papillae, circular, paired in XVII, and pre and postsetal next to male pores in XVIII within male porophore.

First dorsal pore 12/13. Five pairs of spermathecal pores in 4/5-8/9, inconspicuous, 0.17 circumference apart ventrally; distance between spermathecal pores 1.5 mm. Female pores paired in XIV, on 0.5 mm oval. Male pores at lateral margin of ventrum, 0.24 circumference apart ventrally; distance between male pores 1.8 mm.

Septa 5/6-6/7 thin, 7/8 thick, 8/9, 9/10 absent, 10/11-13/14 thick. Gizzard in VIII-X, intestine begins in XV; intestinal caeca simple, originating in XXII, each consisting of a small triangle-shaped sac; typhlosole simple fold about 1/3 lumen diameter from XXII. Hearts XI-XII esophageal, IX lateral.

Ovaries and funnels in XIII. Spermathecae in V-IX; no nephridia on spermathecal ducts; spermatheca with small strawberry-shaped ampulla, duct short; diverticulum sausage-shaped, shorter than ampulla. Male sexual system holandric, testes and funnels in dorsally joined sacs in X, XI. Seminal vesicles two pairs in XI, XII. Prostates in XVI-XIX without copulatory pouches, 6-7 small lobes, duct long, slender with short ectal muscular portion.

REMARKS: *Pithemera fragumae* sp. n. also keys to the *bicincta*-group. The new species without septum 9/10 is thereby unique among known *bicincta* group species. *Pithemera fragumae* sp. n. is similar to *Pi. rotunda* James and Hong, 2004, with respect to spermatheca and diverticulum shape, but easily is distinguished by the genital

papillae. *Pithemera fragumae* sp. n. has circular paired genital papillae in XVII, and paired pre- and postsetal genital papillae next to the male pores within the male porophore on XVIII, but *Pi. rotunda* has three circular papillae in each of segments XVIII to XXII. *Pithemera fragumae* sp. n. has hearts in XI-XII, but *Pi. rotunda* has in X-XII. *Pi. rotunda* also has fewer setae in VII, XX, and between male pores, than *Pithemera fragumae* sp. n.

***Pithemera ifugaoensis* sp. n.**

Figs 2E-F

MATERIAL: Holotype, clitellate (NMA 4180), Philippines, Ifugao province, Banaue ($16^{\circ} 54.97'N$, $126^{\circ} 03.60'E$), 1070 m, soil and litter layers, 16 March 2001, Y. Hong & A. Castillo colls. – 1 paratype, 1 clitellate (NMA 4189), same data as for holotype. – Other material: same data as for holotype, 1 clitellate, 5 semiclitellate specimens.

ETYMOLOGY: The species is named for its type locality.

DIAGNOSIS: Five pairs of spermathecal pores in 4/5-8/9. Genital markings, paired 0.4 mm raised circles on 19/20, 0.7 mm circles paired in XX with sessile genital marking glands.

DESCRIPTION: Light brown dorsal and ventral pigment. Dimensions 38-65 mm by 3.0-4.7 mm at segment X, 3.3-5.0 mm at XXX, 2.8-4.5 mm at clitellum, segments 59-101. Body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 41 at VII, 44 at XX; 8-10 between male pores; setal formula AA:AB:YZ:ZZ = 2:1.5:1:1.5 at XIII. Prostomium epilobic with tongue open. Clitellum annular XIV-XVI; setae visible externally. Genital markings paired 0.4 mm raised circles on 19/20, 0.7 mm circles paired in XX, medio-ventral.

First dorsal pore 12/13. Five pairs of spermathecal pores in 4/5-8/9, on small, conspicuous protuberances, 0.14-0.21 circumference apart ventrally; distance between spermathecal pores 2.0 mm. Female pores paired in XIV, on 0.4 mm circle. Male pores slightly protuberant white spots at center of 0.5 mm round porophores, lateral in XVIII, 0.15-0.24 circumference apart ventrally; distance between male pores 2.1 mm.

Septa 5/6-7/8 thin, 8/9 absent, 9/10-13/14 thin. Gizzard in VIII-IX, intestine begins in XV; intestinal caeca simple, originating in XXII, and extending anteriorly about to XXI (or XXII), each consisting of a small finger-shaped sac; typhlosole simple fold about 1/6 lumen diameter from XXII. Hearts X-XII esophageal; IX lateral.

Ovaries and funnels in XIII. Spermatheca in V-IX; no nephridia on spermathecal ducts; spermatheca with pointed ovate-shaped ampulla, duct thick, non muscular, shorter than ampulla; diverticulum slender, small seed-shaped pouch, as long as ampulla. Male sexual system holandric, testes and funnels in large sac in each of X, XI. Seminal vesicles two pairs in XI, XII. Prostates two main lobes without copulatory pouches, each divided into 4-7 lobes in XVI-XIX, ectal half of duct thick, muscular, spindle-shaped; ental half of duct thin. Genital marking glands diffuse, sessile, paired in XIX, XX.

REMARKS: This species also keys to the *bicincta*-group, but can be distinguished by its genital markings, genital pore spacings, and genital marking glands. *Pithemera ifugaoensis* sp. n. appears to be related to *Pi. lanyuensis* with round male pore region and genital papillae. *Pithemera ifugaoensis* sp. n. has genital papillae as paired raised

circles on 19/20, and larger circles paired in XX, closer to the mid-ventral line, but *Pi. lanyuensis* has paired presetal genital papillae in XX. The spermathecal pores of *Pithemera ifugaoensis* sp. n. are 0.14-0.21 circumference apart, but those of *Pi. lanyuensis* are 0.25-0.33 circumference apart. *Pithemera ifugaoensis* sp. n. also is diagnosed by the diffuse sessile genital marking glands in XIX, XX, but *Pi. lanyuensis* has solid pad-like genital marking glands in XX.

***Pithemera triangulata* sp. n.**

Figs 2G-H

MATERIAL: Holotype, clitellate (NMA 4181), Philippines, Ifugao province, Banaue ($16^{\circ} 54.86'N$, $121^{\circ} 03.54'E$), 1900 m, soil and litter layers, 17 March 2001, Y. Hong & A. Castillo colls. – 3 paratypes, 1 clitellate (NMA 4190), 1 clitellate (MHNG 49297), 1 clitellate (NIBR), same data as for holotype. – Other material: Banaue ($16^{\circ} 58.59'N$, $121^{\circ} 02.89'E$), 1600-1665 m, soil and litter layers, 5 clitellate, 2 semiclitellate, 17 March 2001, Y. Hong & A. Castillo colls. – Same data as for holotype, 5 clitellate specimens.

ETYMOLOGY: The species is named *triangulata*, referring to the shape of the intestinal caecum.

DIAGNOSIS: Three pairs of spermathecal pores in 4/5-6/7. Male pores near inner edges of 0.8 mm oval pads extending to 17/18 and 18/19 within thickened white area. Genital papillae lacking.

DESCRIPTION: Light brown dorsal pigment. Dimensions 47-76 mm by 2.5 mm at segment X, 2.7 mm at XXX, 2.5 mm at clitellum, segments 86-99. Body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 41 at VII, 44 at XX; 1-3 between male pores; setal formula AA:AB:YZ:ZZ = 2:1:1.5:4 at XIII. Prostomium epilobic with tongue open. Clitellum annular XIV-1/2XVI; XVI setae visible externally. Genital markings lacking.

First dorsal pore 12/13. Three pairs of spermathecal pores in 4/5-6/7, inconspicuous, 0.06 circumference apart ventrally; distance between male pores 0.5 mm. Female pores paired in XIV, in 0.4 mm circle. Male pores near inner edges of 0.8 mm oval pads extending to 17/18 and 18/19 within thickened white area, 0.1 circumference apart ventrally; distance between male pores 0.8 mm.

Septa 5/6-7/8 thin, 8/9 absent, 9/10 thin, 10/11-13/14 thin. Gizzard in VIII-IX, intestine begins in XV, lymph glands along dorsal vessel from about XX; intestinal caeca simple, originating in XXII, and extending antero-ventrally, each consisting of a small triangle-shaped sac; typhlosole simple fold about 1/4 lumen diameter from XXII. Hearts X-XII esophageal; VII-IX lateral; hearts X, XI within testes sacs.

Ovaries and funnels in XIII. Spermathecae in V-VII; no nephridia on spermathecal ducts; spermatheca with large ampulla, duct medium thick, not muscular, as long as ampulla; diverticulum chamber digitate, slender, as long as spermathecal duct, stalks very short. Male sexual system holandric, testes and funnels in paired large sacs in X, XI. Seminal vesicles two pairs in XI, XII. Prostates 3-4 lobes in XVIII without copulatory pouches, ectal half of duct muscular, fusiform, ental half of duct thin; diffuse glandular patches on body wall 17/18-18/19.

REMARKS: In Sims and Easton (1972) *Pithemera triangulata* sp. n. keys to the *bicincta*-group, because species with first spermathecal pores in 4/5 are assigned to the

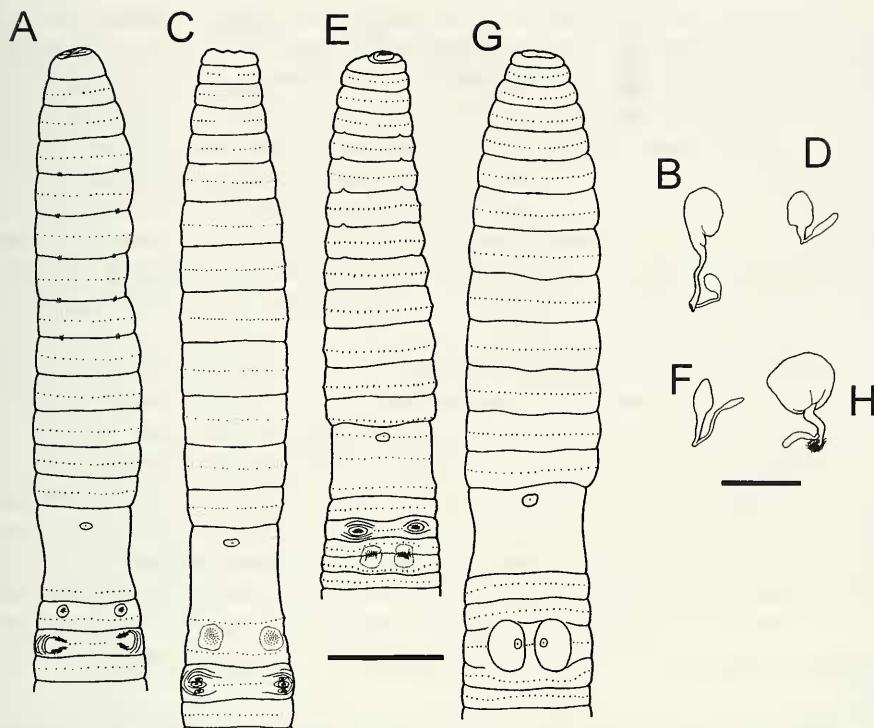


FIG. 2

Pithemera duhuani sp. n. (A) Ventral view. (B) Spermathecae and diverticulum. *Pithemera fragumae* sp. n. (C) Ventral view. (D) Spermathecae and diverticulum. *Pithemera ifugaoensis* sp. n. (E) ventral view. (F) Spermathecae and diverticulum. *Pithemera triangulata* sp. n. (G) Ventral view. (H) Spermathecae and diverticulum. Scale bars = 2.5 mm (A, C, E, G), 2 mm (B, D, F, H).

bicincta group regardless of the number of spermathecae. This species has three pairs of spermathecal pores in 4/5-6/7. *Pithemera triangulata* sp. n. differs from other *Pithemera* in having the ampulla as long as the duct, and the duct as long as the diverticulum, 3 pairs of spermathecae, and no genital papillae. It has a male porophore like the pads on discs found in some mainland Asian *Amynthas* species.

Polypheretima fruticosa sp. n.

Figs 3A-B

MATERIAL: Holotype, clitellate (NMA 4182), Philippines, Ifugao province, Banaue ($16^{\circ} 56.98'N$, $121^{\circ} 03.41'E$), 1400 m, soil and litter layers, 18 March 2001, Y. Hong & A. Castillo colls. – 3 paratypes, 1 clitellate (NMA 4191), 1 clitellate (MHNG 49298), 1 clitellate (NIBR), same data as for holotype. – Other material: same data as for holotype, 5 clitellate specimens.

ETYMOLOGY: The name *fruticosa* is Latin for bushy, here referring to the shape of the seminal vesicles.

DIAGNOSIS: One pair of spermathecal pores in 5/6. Small, round genital papillae paired in XVIII or XIX on lateral margin.

DESCRIPTION: Brown dorsal pigment. Dimensions 39-61 mm by 2.3 mm at segment X, 2.0 mm at XXX, 2.0 mm at clitellum, segments 105-107. Body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 44 at VII, 41 at XX; 9 between male pores; setal formula AA:AB = 1.5:1.0 at YZ:ZZ = no gap at XIII. Prostomium epilobic with tongue open. Clitellum annular XIV-XVI. Genital papillae paired in XVIII or XIX on lateral margin, small, round, dark.

First dorsal pore 11/12. One pair of spermathecal pores in 5/6 at lateral margin, inconspicuous, 0.25 circumference apart ventrally; distance between spermathecal pores 1.8 mm. Female pore single in XIV, in 0.4 mm circle. Male pores in XVIII on 0.5 mm round porophores in lateral margin, slightly protuberant, 0.27 circumference apart ventrally; distance between male pores 1.7 mm.

Septa 5/6-7/8 thick, 8/9 absent, 9/10 thin, 10/11 thick, 11/12-13/14 thin. Gizzard in VIII-IX, intestine begins in XV; intestinal caeca absent; typhlosole large fold about 1/2 lumen diameter from about XX. Hearts X-XII esophageal; IX lateral.

Ovaries and funnels in XIII. Spermathecae in VI; no nephridia on spermathecal ducts; spermatheca with small ampulla, duct shorter than ampulla, not muscular; diverticulum slender, longer than ampulla. Male sexual system holandric, testes and funnels in large sac in X, XI; sacs not including hearts. Seminal vesicles two pairs in XI, XII, those of XII consist of solid ventral, bushy dorsal sections. Prostates in XVIII-XXII without copulatory pouches, duct gradually thickened ectally, becoming muscular; vas deferens join prostatic duct about 1/3 of the duct from gland to body wall.

REMARKS: The present species appears to be closely related to *Po. voeltzkowi* (Michaelsen, 1907), but is separated by the genital papillae. *Polypheretima voeltzkowi* has simple, paired, postsetal papillae on XVII, and pre- and postsetal papillae medial to male pores on XVIII. However, *Polypheretima fruticosa* sp. n. has only one pair of genital papillae on XVIII or XIX, and they are of a different shape. Also the species is similar to *Po. fida* (Michaelsen, 1913), but differs by the lower number of spermathecal pores: *Po. fida* has two or three intersegmental spermathecal pores in 4/5, 5/6, or 4/5-6/7. *Polypheretima fruticosa* sp. n. only has one pair of intersegmental spermathecal pores in 5/6. Easton (1979) distinguished different groups of *Polypheretima* species by the location of spermathecal pores, intrasegmental or intersegmental. The spermathecal pores of *Po. fida* and *Polypheretima fruticosa* sp. n. are intersegmental, whereas those of *Po. voeltzkowi* are intrasegmental.

Polypheretima perlucidula sp. n.

Figs 3C-D

MATERIAL: Holotype, clitellate (NMA 4183), Philippines, Ifugao province, Banaue ($16^{\circ} 56.98'N$, $121^{\circ} 03.41'E$), 1400 m, soil and litter layers, 18 March 2001, Y. Hong & A. Castillo colls. – 3 paratypes, 1 clitellate (NMA 4192), 1 clitellate (MHNG 49299), 1 clitellate (NIBR), same data as for holotype. – Other material, same data as for holotype, 10 clitellate, 7 a clitellate specimens.

ETYMOLOGY: The epithet *perlucidula* is Latin for transparent, referring to the transparent spermathecal diverticula.

DIAGNOSIS: Two pairs of spermathecal pores in 5/6, 6/7. Genital markings lacking.

DESCRIPTION: Worm unpigmented. Dimensions 38-56 mm by 1.5 mm at segment X, 1.3 mm at XXX, 1.5 mm at clitellum, segments 117-131. Body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 50 at VII, 23 at XX; 12 between male pores; setal formula AA:AB:YZ:ZZ = 1.5:1:1:1.5 at XIII. Prostomium epilobic with tongue open. Clitellum annular XIV-XVI. Genital markings absent.

First dorsal pore 12/13. Two pairs of spermathecal pores in 5/6, 6/7, at lateral margin, inconspicuous, 0.28 circumference apart ventrally; distance between spermathecal pores 1.3 mm. Female pore single in XIV, on 0.2 mm circular area. Male pores on 0.3 mm round porophores at lateral margins in XVIII, slightly protuberant, 0.32 circumference apart ventrally; distance between male pores 1.3 mm.

Septa 5/6-7/8 thick, 8/9, 9/10-13/14 thin. Gizzard in VIII, intestine begins in XV; intestinal caeca absent; typhlosole large fold almost equal to lumen diameter from about XXII. Hearts X-XII esophageal; IX lateral.

Ovaries and funnels in XIII. Spermathecae in VI, VII; no nephridia on spermathecal ducts; spermatheca with very small ampulla, duct thick, longer than ampulla, not muscular; diverticulum club-shaped, shorter than ampulla, transparent, without visible contents. Male sexual system holandric, testes and funnels in X, XI, within dorsally joined sacs. Seminal vesicles two pairs in XI, XII, reduced. Prostates in XVII-XX without copulatory pouches, duct thick, muscular, cylindrical.

REMARKS: *Polypheretima perlucidula* sp. n. keys to the *bifaria*-species group in Easton (1979). Among them, the new species is similar to *Polypheretima sempolensis* (Easton, 1979) with spermathecal pores in furrows 5/6 and 6/7. *Po. sempolensis* has genital markings in XVII and XIX, but the present species has no post-clitellar genital markings. The genital markings of *Po. sempolensis* are large, encroaching on the setal lines and the intersegmental lines. The new species spermathecal pores are 0.28 circumference apart, but those of *Po. sempolensis* are 0.33 body circumference apart. *Polypheretima perlucidula* sp. n. has fewer setae than *Po. sempolensis* (50 vs. 60-66 on VII, 23 vs. 44-48 on XX), and *Po. sempolensis* (100-107 segments) has fewer segments than *Polypheretima perlucidula* sp. n.

***Polypheretima bannaworensis* sp. n.**

Figs 3E-F

MATERIAL: Holotype, clitellate (NMA 4185), Philippines, Ifugao province, Banaue (16° 54.86'N, 121° 03.54'E), 1900 m, soil and litter layers, 17 March 2001, Y. Hong & A. Castillo colls. – 3 paratypes: 1 clitellate (NMA 4193), 1 clitellate (MHNG 49300), 1 clitellate (NIBR), same data as for holotype. – 7 clitellate specimens.

ETYMOLOGY: The species is named for its type locality. Bannawor is the original name for Banaue in the language of the local people.

DIAGNOSIS: Four pairs of spermathecal pores in 5/6-8/9, male pores on 0.5 mm round porophores in lateral XVIII, surrounded by circular furrows.

DESCRIPTION: Brownish dorsal pigment. Dimensions 51-74 mm by 2.7-3.7 mm at segment X, 3.1-3.3 mm at XXX, 2.6-3.2 mm at clitellum, segments 67-95. Body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 39 at VII, 46 at XX; 6-7 between male pores; setal formula AA:AB:YZ:ZZ

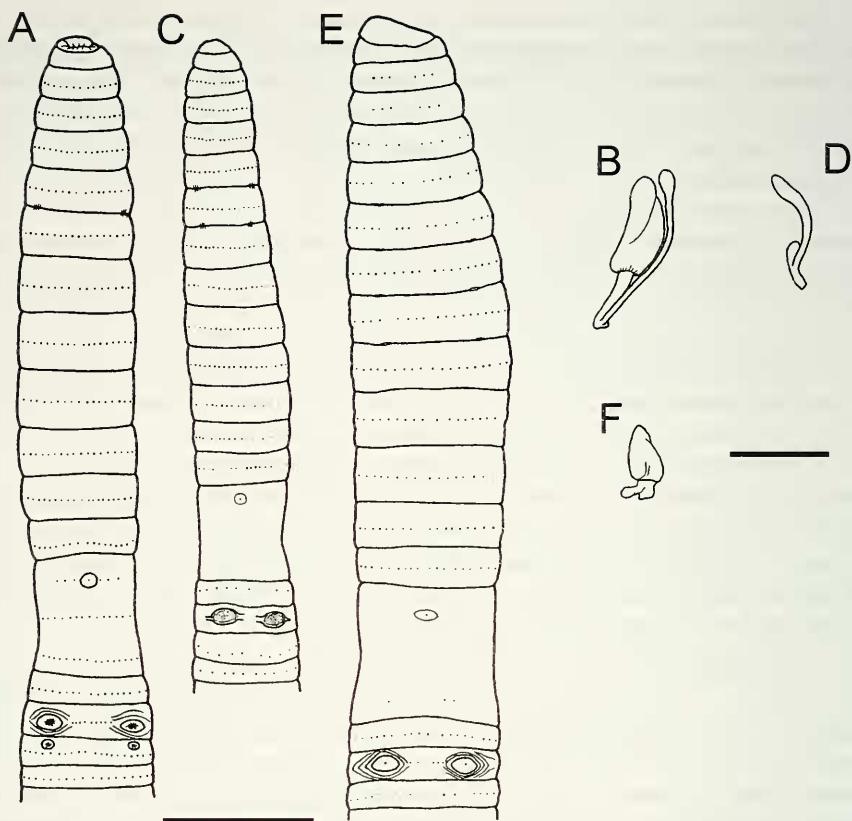


FIG. 3

Polypheretima fruticosa sp. n. (A) Ventral view. (B) Spermathecae and diverticulum. *Polypheretima perlucidula* sp. n. (C) Ventral view. (D) Spermathecae and diverticulum. *Polypheretima bannaworensis* sp. n. (E) Ventral view. (F) Spermathecae and diverticulum. Scale bars = 2.5 mm (A, C, E), 2 mm (B, D, F).

= 2:2:2:3 at XIII. Prostomium epilobic with tongue open. Clitellum annular XIV-XVI; setae in XVI visible externally.

First dorsal pore 11/12. Four pairs of spermathecal pores in 5/6-8/9, 0.22-0.25 circumference apart ventrally; distance between spermathecal pores 2.4 mm. Female pore single in XIV, on 0.3 mm oval. Male pores white spots on 0.5 mm round porophores in lateral XVIII, surrounded by circular furrows, slightly protuberant, 0.20-0.24 circumference apart ventrally; distance between spermathecal pores 2.0 mm. Genital markings lacking.

Septa 5/6-8/9 thick, 9/10-13/14 thin. Gizzard in VIII, intestine begins in XV, small lymph glands with dorsal vessel; intestinal caeca absent; typhlosole very low from about XXII. Hearts X-XII esophageal; IX lateral.

Ovaries and funnels in XIII. Spermathecae in VI-IX; no nephridia on spermathecal ducts; spermatheca with small strawberry-shaped ampulla, duct thick, shorter than ampulla; ovate diverticulum short, as long as duct. Male sexual system holandric,

testes and funnels in large sac in X, XI. Seminal vesicles two pairs in XI, XII. Prostates in XVI- XX without copulatory pouches, duct thin, short.

REMARKS: The species shares the spermathecal pores in 5/6-8/9, and large male porophores with *Po. bifaria* (Michaelsen, 1923) and *Po. monticola* (Beddard, 1912). Michaelsen recorded two subspecies of *bifaria*, one with single and the other with paired genital markings (Michaelsen, 1938; Easton, 1979). *Po. bifaria* has numerous spermathecal pores in paired batteries in furrows 5/6/7/8 and usually in 8/9, and 1-3 spermathecae in paired batteries VI-VIII and usually in IX. It has paired pre or post-setal genital markings on V-VIII, and occasionally IX pre- and postsetal on XVIII, presetal on XVII and XIX, and occasionally XX (Easton, 1979), but the present species has no genital markings at all and more importantly is bithecal rather than polythecal. The new species spermathecal pores are 0.20-0.24 circumference apart, but those of *Po. bifaria* are 0.30 circumference apart. The new species is longer than *Po. bifaria* (length 27-49 mm), but has fewer segments than *Po. bifaria* (99-110 segments). The *Po. bifaria* species were collected from New Guinea. The new species has the same spermathecal locations as *Po. monticola*, which differs by having large circular or oval, presetal, paired genital markings on IX, XVII, and XIX-XX (Easton, 1979). The *Po. monticola* specimens were recorded from Mt. Pulag, Luzon, Philippines, which is south of Banuae in the same mountain range.

ACKNOWLEDGEMENTS

This study was supported by National Science Foundation grant DEB-0072764 to the corresponding author, and partially by the Korea Research Foundation Grant (KRF-2004-050-C00019). We are grateful to the cooperation of Philippine Department of Environment and Natural Resources personnel for assistance in the field and for allowing collection permits.

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